

REMARKS

The official action dated September 23, 2005 has been received and its contents carefully noted. In view thereof, claim 9 has been amended in order to better define that which Applicant's regard as the invention. As previously, claims 3 through 18 are presently pending in the instant application with claims 11 through 18 being withdrawn from further consideration by Examiner being directed to a non-elected invention.

Initially, applicant wishes to again acknowledge the Examiner's indication that claims 7 and 8 are allowable with a prior art record. With the foregoing amendments, it is respectfully submitted that Applicants claimed invention as set forth in claims 3 through 10 is in proper condition for allowance and indication of such is earnestly solicited.

With reference to the Official Action, and particularly page 2 thereof, claim 9 has been rejected under 35 USC 102(e) as being anticipated by U.S. Patent No. 6472317 issued to Wang et al. This rejection is respectfully traverses in that the patent to Wang et al. neither discloses or suggests that which presently set forth by applicant's claimed invention.

As can be seen from the foregoing amendments, independent claim 9 has been amended to recite an etching method comprising the steps of performing anisotropic etching with respect to an inner layer insulating film composed of an organic-inorganic hybrid film containing an organic component and a silica component by using a plasma derived from an etching gas containing N₂ gas and a fluorinated hydrocarbon gas as main constituents, but containing no O₂ gas as a component. That is, in accordance with Applicant's claimed invention, the etching method set forth therein allows anisotropic etching to be performed with respect to an inner layer insulating film composed of an organic-inorganic hybrid film

containing the organic component and a silica component as the main constituents.

In accordance with the etching method of the present invention, active hydrogen generated from the fluorinated hydrocarbon gas decomposes the organic component in the organic-inorganic hybrid film into hydrogen cyanide, while fluorine generated from the fluorinated hydrocarbon gas decomposes the inorganic component in the organic-inorganic hybrid film, so that etching with respect to the organic-inorganic hybrid film proceeds. Furthermore, in the process set forth in accordance with Applicant's claimed invention, a surface of the organic-inorganic hybrid film is efficiently nitrided by nitrogen so that the side walls of a depression portion in the organic-inorganic hybrid film are protected resulting in an excellent anisotropic property. In order to accomplish this, the etching gas used in accordance with Applicant's claimed invention, contains nitrogen gas and fluorinated hydrocarbon as the main constituents and does not contain a component which oxidizes the organic-inorganic hybrid film. Thus, in accordance with applicant's claimed invention, the above noted effect and the significant effect that the organic-inorganic hybrid film is not oxidized is accomplished.

With respect to the teachings of Wang et al., this reference merely discloses using a mixture gas containing N_2/H_2 and possibly a slight amount of $C_xH_yF_z$ for anisotropic etching of the dielectric layer 14 made of an organic-inorganic material such as BCB (HSQ as an inorganic material) as set forth in column 5 lines 36 through 50 and column 6 lines 5 through 24 and 50 through 54. In accordance with the teachings of Wang et al., Wang et al. uses the mixture gas containing a slight amount of $C_xH_yF_z$ whereas the present invention uses an etching gas containing nitrogen gas and fluorinated hydrocarbon as the main constituents, and thus the main constituents of the etching gas of the present invention are significantly

different from those set forth in Wang et al. Furthermore, with Wang et al., a problem exists in that the etching speed of the siloxane component (inorganic component) is much slower than the etching speed of the organic component so that etch residues of the siloxane component (SiO_2 being the main constituent) are generated. On the other hand, the etching gas of the present invention contains fluorinated hydrocarbon as the main constituent, and thus etching with respect to the organic compound in the organic-inorganic hybrid film proceeds simultaneously with etching with respect to the inorganic compound. As a result, etch residues or the like are not generated in accordance with the present invention. Accordingly, it is respectfully submitted that Applicant's claimed invention as set forth in independent claim 9 clearly distinguishes over the teachings of Wang et al. and is in proper condition for allowance.

With reference to page 3 of the Office Action, claims 9 and 10 have been rejected under 35 U.S.C. 102(e) as being anticipated by U.S. Patent No. 6,168,726 issued to Li et al. This rejection is likewise respectfully traversed in that the patent to Li et al. neither discloses nor suggests that which is presently set forth by Applicants claimed invention.

In rejecting Applicants claimed invention, the Examiner states that Li et al. teaches the anisotropic plasma etching of organo-silane films. The Examiner further states that Li et al. teaches generating a plasma from an oxygen-free gas mixture comprising a fluorohydrocarbon, N_2 and Ar. The examiner further directs the Applicant's attention to column 6, lines 34 through 43 and column 12, line 66 through column 13, line 2.

In reviewing the Li et al. disclosure, it is noted that this reference sets forth anisotropic etching using an etching gas which comprises a fluorocarbon and a chemically inactive gas such as argon as noted from column 6, lines 34 through 50. Fluorocarbon (CF_3)

and argon disclosed in Li et al. contain no hydrogen component whereas the nitrogen gas and fluorinated hydrocarbon of the present invention contain a hydrogen component. Consequently, Li et al. can not obtain the effect that active hydrogen efficiently decomposes the organic component in the organic-inorganic hybrid film into hydrogen cyanide as is the case with the present invention. Further, the etching gas of Li et al. contains fluorocarbon and argon and uses the N₂ gas or O₂ gas as an added gas. Therefore, the N₂ gas is not a main constituent. As can be appreciated from columns 12 and 13, the added gas of Li et al is used for preventing etch stop in the second step of a deep etch. On the other hand, the etching gas of the present invention contains the nitrogen gas as one of the main constituents, which is clearly different from that of Li et al. Therefore, Li et al. does not obtain the effect that a surface of the organic-inorganic hybrid film is efficiently nitrified by nitrogen so that the side walls of a depressed portion in the organic-inorganic hybrid film are protected and therefore provides an excellent anisotropic property as is the case with the present invention. Moreover, in a case where the O₂ gas is employed as an added gas to the etching gas as is the case in Li et al., the etching gas is totally different from that of the present invention because the etching gas of the present invention contains no O₂ gas. Therefore, Li et al. does not, and can not obtain the significant effect of the present invention, that is, the effect that the organic-inorganic hybrid film is not oxidized.

While Li et al. further discloses that hydrofluorocarbon maybe used instead of fluorocarbon as noted in column 14, lines 36 through 41, it is noted that the N₂ gas is also used as the added gas, and thus Li et al. is significantly different from that of the present invention. Accordingly, it is respectfully submitted that Applicant's claimed invention as set forth in each of claims 9 and 10 clearly distinguishes over the teachings of Li et al. and is in proper condition for allowance.

With further reference to page 3 of the Office Action claims 3 through 6, 9 and 10 have been rejected under 35 U.S.C. 103(a) as being unpatentable over Japanese Patent Publication 10-268526 issued to Sato. This rejection with respectfully traversed in that Sato likewise fails to disclose or render obvious that which is presently set forth by Applicants claimed invention.

With respect to independent claims 3 and 5, each of these claims recite features similar to that of independent claim 9 and particularly recite that no component which oxidizes the organic component is included in the etching gas. With respect to the teachings of Sato, this reference discloses anisotropic etching with respect to the insulating film composed of organic-inorganic material. Sato discloses the silicon organic film 13 containing the compound which has siloxane bond (Si-O bond) as noted in paragraph [0066], and the source gas of etching of the silicon organic film 13, paragraph [0088]. Some of the gases disclosed in paragraph [0088] are the same as those set forth in the present invention. However, the gases disclosed in paragraph [0088] contain CO and O₂. Thus, the etching gas of Sato is different from that of the present invention which contains no component which oxidizes the organic-inorganic hydride film.

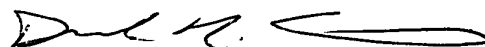
Furthermore, the source gas of the etching process disclosed in paragraphs [0050] and [0060] is a gas used in the collective etching of the silicon film 4 and the silicon organic film 3 or the etching of the silicon oxide film as noted from paragraph [0063], not a gas used in the etching of the siloxane bond. The source gas of the etching changes depending upon the bonds to be etched. Therefore, even when the source gas of the etching of the silicon film or the silicon oxide film which have Si-Si bonds is applied to the compound having siloxane bond, it is respectfully submitted that the present invention wherein it is specifically recited

that no component which oxidizes the organic compound is used would not have been rendered obvious to one of ordinary skill in the art but for the existence of Applicants disclosure. Therefore, it is respectfully submitted that Applicants claimed invention as set forth in each of independent claims 3, 5 and 9 clearly distinguish over the teaching of Li et al. and are proper condition for allowance along with those claims which depend therefrom.

Therefore, in view of the foregoing, it is respectfully requested that the rejections of record be reconsidered and withdrawn by the Examiner, that claims 3 through 10 be allowed and that the application be passed to issue.

Should the examiner believe that a conference would be a benefit in expediting the prosecute the instant application, he is hereby invited to telephone counsel to arrange such a conference.

Respectfully submitted,



Donald R. Studebaker
Reg. No. 32,815

Nixon Peabody LLP
401 9th Street N.W.
Suite 900
Washington, D. C. 20004
(202) 585-8000